

FOCUS: PRODUCTS AND TECHNOLOGY

U.S. Water Services' is taking Big River Resources' water treatment to the next level in technology. This is the first time an ethanol plant will use the advanced technologies of High Efficiency Reverse Osmosis and Evaporation - Crystallization together. Combining these two processes will eliminate all liquid discharge from this ethanol plant, greatly simplifying permitting approval.

Big River Resources is building a 100 million gallon per year ethanol plant in Galva, IL that is expected to start-up early 2009.

Big River Resources (BRR) had to consider several treatment options due to the high mineral content in the local well water. In addition, discharge was an issue and BRR was looking at running pipelines to the closest river 30 miles away.

The water issues confronting this plant were not straight forward, and U.S. Water Services was asked to design a water treatment process to deal with these challenges.

There are four major processes the water will go through. The first process is Dual Softening, consisting of a strong acid cation cycle and a weak acid cation. The second process is a Decarbonator which greatly reduces carbon dioxide. The HERO will raise the pH to 10 in the third process, whereby water recoveries of 95-97% can be achieved, thus greatly reducing discharge volumes. The last process is Evaporation and Crystallization, where Zero Liquid Discharge results can be achieved by evaporating down the waste stream volume by 80-90%. The remainder is then crystallized to a land fillable solid that is non-hazardous to the environment.

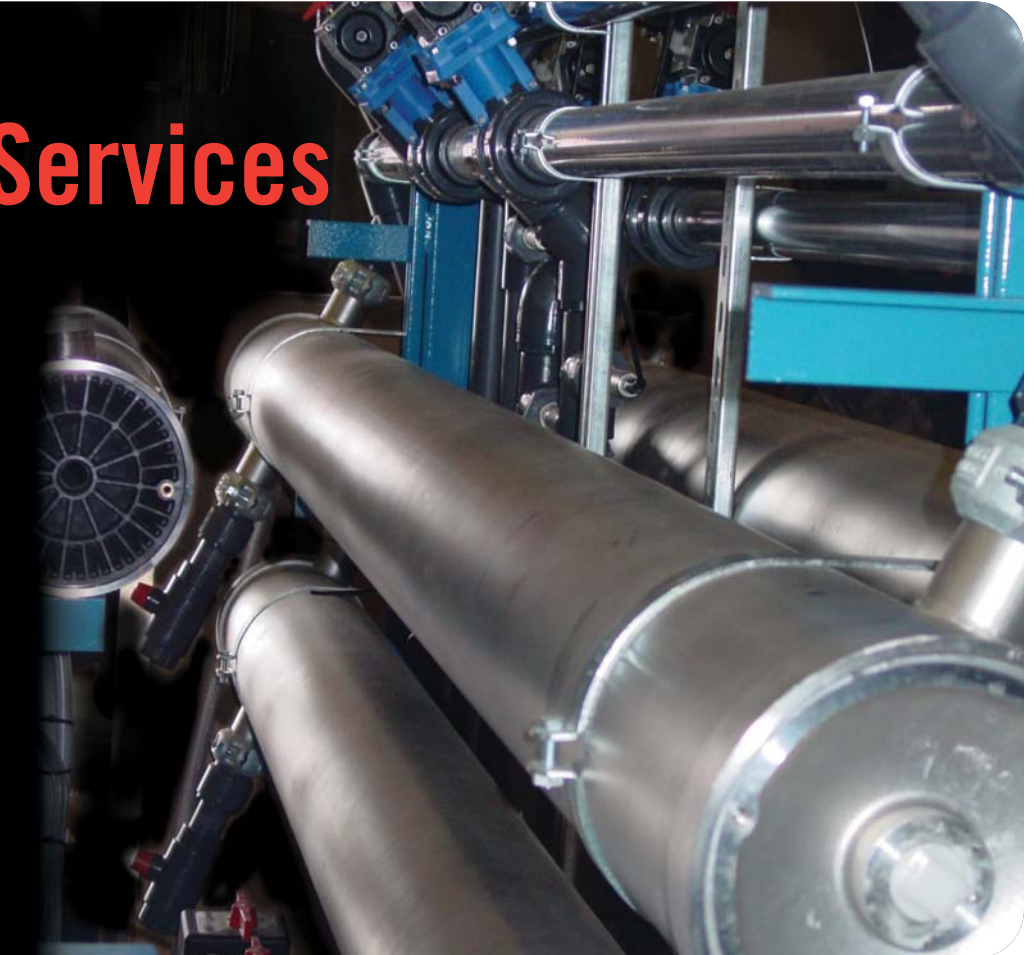
U.S. Water Services' presented this turn key proposal to BRR and signed the agreement with them October 2007. The primary contractor on the water treatment building will be U.S. Water Services. Mobilization is slated to begin in February 2008, with completion occurring by December 2008. This will put BRR on track for the plant's scheduled start-up in early 2009.

For more information on these unique new products, please contact your U.S. Water Services representative or visit our website at www.uswaterservices.com.



U.S. Water Services Introduces New RO Cleaning Station

U.S. Water Services has completed the construction of its own RO/NF membrane cleaning station designed to better service its customers' needs.



In This Issue:



PAGE 2
CASE STUDY:
RO Cleaning



PAGE 2
Presenting
the new RO
Platform



PAGE 3
RO Membrane
Autopsies



PAGE 4
Achieving Zero
Liquid
Discharge

U.S. Water Services will now offer our own membrane cleaning service to provide more thorough cleaning service for elements pulled from field units suffering from challenging fouling conditions. Also, by keeping this work in-house, knowledge will be gained that can be directly applied to those troublesome systems. This will be a valuable service for our customers.

U.S. Water Services will be able to apply this cleaning station in a number of ways. It can be used to learn more about the nature of a fouling material and to trial new cleaning formulations. The cleaning station can be used to aggressively clean elements specifically

affected by isolated fouling problems in a membrane system. For example, if there is lead-end fouling or scale formation at the tail end, only the affected membrane elements will have to be cleaned. The design of the cleaning station also allows reverse flow cleanings, resulting in more complete removal of particulate or organic fouling located on the very front of membrane element banks.

U.S. Water Services designed the cleaning station with highly sophisticated programming for experimentation with different control techniques and in return will gain more insight on automation, automatic controls, and automating

processes.

The U.S. Water Services' in-house cleaning station includes the capability of wet testing a membrane element under the same test conditions as those used by the membrane manufacturers. The test station will be able to identify the effectiveness of cleaning performed with the membrane element. Another function of the test station would be to check the performance of a membrane element prior to doing a membrane autopsy to be certain that the given element demonstrates the symptoms being investigated. This alone can save customers time and money.

2950 Xenium Lane North
Suite 120
Plymouth, MN 55441

Case Study

After months of operation, the RO system at a 50 million gallon per year ethanol plant in the Midwest began experiencing progressive increases in pressure differential (Delta P) between primary and final RO pressures.

The plant tried conventional CIP procedures using high and low pH cleaners, as well as heavy doses of non-oxidizing biocides. Unfortunately, these conventional cleanings did not have the desired effect of reducing pressure differential across the system.

The plant then removed membranes from their RO system to send them out for cleaning and replaced them with refurbished membranes until they returned. This was the only way the plant could manage the RO system pressures. The problem with high Delta P is that fouling can quickly become irreversible and even rupture membranes if the pressure gets too high.

In order to determine the root cause of the problem U.S. Water Services and the customer opened up the RO system for inspection and sent in a membrane for RO autopsy. The system was caked with iron fouling and slime forming bacteria.

So the question was could anything be done to control the bacteria to eliminate the problem.

The unusual solution was to control the bacteria using U.S. Water Services Stabrom; stabilized bromine chemistry, which provided a halogen punch, but is less aggressive to the RO membranes than bleach or other oxidants.

The bleach being fed ahead of the multimedia filters was replaced with Stabrom. A positive halogen residual was maintained in order to oxidize iron and remove it efficiently in the filters. The excess stabilized bromine was allowed to flow into the RO, where it prevented the growth of bacteria slime in the membrane elements. This achieved the reduced pressure differential across the RO system that we were after.

The improvement in performance on this system was dramatic. The Delta P across the RO was reduced from 195 to 140 psig. In addition, the normalized flow was increased from 388 gpm up to 492 gpm, a 27% improvement in available water production.

This was an unorthodox solution to a difficult problem, and was definitely an example of outside the box thinking. Before trying to feed any oxidant to a RO membrane element, be sure to consult with your water treatment representative, in order to prevent damage to your system.

It's Not Easy Being Green



U.S. Water Services Presents Their New Reverse Osmosis Platform

U.S. Water Services designed our new RO Platform based on our hard won field experience in combination with environmentally oriented system optimization.

Our new RO design is built like a tank, performs like a sports car, and has the energy efficiency of a hybrid. It offers a stronger support structure, higher quality stainless steel and instrumentation, and reduced permeate flux rates with better balance for reduced membrane fouling. The platform is designed with additional biocide feed and control options, greater hydraulic flexibility, and will minimize water usage while maximizing membrane performance.

U.S. Water Services has designed our new platform with a variable frequency drive (VFD), which controls the speed of the motor on the high pressure pump. The VFD efficiently controls the pressure and flow from the pump without using an energy inefficient throttle valve. It can be interlocked with water usage to minimize RO downtime that often contributes to bacterial fouling. The VFD also includes a built-in-soft start that reduces wear-and-tear on the pump and RO membrane, that otherwise

CURRENT PLATFORM	NEW PLATFORM
12 weeks lead time	12 weeks lead time
19 gpsf maximum flux	19 gpsf maximum flux
Throttling valve	VFD
Tube steel frame	I-beam frame
Wimpy pump supports	Reinforced pump frame
PVC inlet piping	Better supported PVC
PVC Permeate piping.	PVC Permeate piping.
PVC & 304 SS concentrate / HP piping	316 SS passivated
2x1 array only	Single bank options, with Recycle
Permeate & concentrate flowmeters	Add inlet (total)
Epoxy coat frame finish	Powdercoat frame finish
(Predominantly) Tonkaflor pump(s)	Grundfos pump(s)
Pre and Post Filter Pressure transducers	Filter differential pressure meter
No permeate valve	Permeate to drain valve (manual)
Thornton probes /controls	Controls upgrade (alarms and by-passes)
Standard biocide feed	3 option biocide feed
	PLC / HMI Surge protection
	Better quality and/or quick-change pressure gauges

result from instantaneous RO start-ups. The VFD often results in tens of thousands of dollars in annual energy savings, depending on the plant and RO system.

The new platform uses highly

reliable Grundfos vertical pumps with all stainless steel welded components and no plastic. They operate with an electrical efficiency around 80%, providing even more energy savings for the customers.

Upcoming Events

LOOK FOR U.S. WATER SERVICES

January

Northwest Food Processors Show
January 14-16
Portland, OR



February

National Biodiesel Conference
February 3-6
Orlando, FL



National Ethanol Conference
February 23-27
Orlando, FL



Plant Engineering & Manufacturing Expo
February 27-28
Milwaukee, WI

March

BOMA Greater Minneapolis Conference
March 15
11:00 - 2:30
Minneapolis Marriott City Center
Minneapolis, MN



April

MN Society for Mining Show
April 14-15
Minneapolis, MN

Autopsy for RO Membranes. A Valuable Tool For You.



The term sounds grim, but it's a good description of the analysis that can be performed on a fouled RO membrane. A membrane autopsy can be the key to determining how to prevent fouling of new membranes, and to maximize the efficiency of this key piece of water treatment equipment. U.S. Water Services performs this analysis in our analytical laboratory in Cambridge, Minnesota, and then issues a comprehensive seven page report of the results. The test is destructive, and the membrane element is not returned.

The procedure begins with a physical examination of the intact element. We start by looking for physical damage to various parts of the element, including the brine seal, outer casing, permeate tube and any evidence of telescoping of the membrane. We next look for evidence of gross fouling on the leading edges of the rolled membrane in the end cap. Fouling in this area can restrict water flow through the element, and the elements behind it in the array tube. If a system is experiencing leading edge fouling, it usually occurs on the first element in each array of the first bank. The fouling is principally a result of dissolved organic material, or fine suspended solids that have made it past

the pre-filter system. Next, the element is taken apart by removal of the end caps, and the membrane is un-rolled. This allows a series of specific tests to determine what has happened to this particular system.

Samples of the membrane will be subjected to dye testing. The dyes are chosen due to the size of their molecules, which prevent the dye from passing through the pores of a normal membrane. The dyes will pass through damage membrane sheets, and will stain the underside of the membrane composite material.

This membrane barrier damage is often caused by exposure to halogens (chlorine and bromine compounds). We use another test, called the Fujiwara analysis, to determine if halogens have reacted with the membrane's polymer structure. Membranes that have been damaged by other oxidants, such as permanganate, ozone or hydrogen peroxide, will not react to this test, so it's possible to determine what type of chemical is causing the damage.

The next step is to collect foulant off of the membrane sheet, and analyze it for chemical composition. The foulant is tested for Loss On Ignitions (LOI) to determine how much is organic mate-

rial. The sample is then analyzed by X-Ray Fluorescence and X-Ray Diffraction, which provides information about the relative concentrations of specific ions, such as iron, calcium, silicon, phosphorous or barium. An example of this type of analysis is shown below:

Primary Composition	Percent (%)
Silicon, SiO ₂	9.88
Iron, Fe ₂ O ₃	22.20
Calcium, CaO	6.28
Phosphorous, P ₂ O ₅	11.50
Barium, BaO	9.60
Magnesium, MgO	1.00
Sulfur	2.24
Strontium, mg/l	2019
Barite, BaSO ₄	16
Amorphous (non-crystalline)	>80
Unidentified	<5

With the information from a complete membrane autopsy, you now have the tools to determine the best approach to prevent issues in the future. If your system is running pretty well, a membrane autopsy can still be useful to develop a baseline of results for your Reverse Osmosis and other pre-treatment equipment. Contact your U.S. Water Representative if you would like to send a membrane element in for analysis.



Corporate Offices:
330 S. Cleveland St.
Cambridge, MN 55008

2950 Xenium Lane North
Suite 120
Plymouth, MN 55441
P (763) 553-0379
F (763) 553-0613

www.uswaterservices.com

